VIDEO CONTENT TRANSMITTING SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

The present invention relates to a video content transmitting system for transmitting video contents requested from a video content play terminal or video viewer terminal. More particularly, the present invention relates to a video content transmitting system having a plurality of video content servers using different video content transmitting network protocols, the video content transmitting system transmitting video contents to a plurality of video content play terminals using different video content receiving network protocols.

With recent high speed and broad bandwidth of the Internet and intranet, it becomes possible to transmit not only text data but also multimedia data such as audio and video data over networks. The International Organization for Standardization are making various standards of specifications to be used for communications over networks.

For example, the Internet Engineering Task Force (IETF) has standardized protocols to be used for communications over networks, such as HTTP (Hyper Text Transfer Protocol (RFC1945)), RTP (Real-time Transfer Protocol (RFC1889)), RSVP (ReSerVation Protocol (RFC2205)) and RTSP (Real Time Streaming Protocol

(RFC2326)). Along with these developments, video content transmitting servers have been realized for transmitting video contents requested by video content play terminals to the terminals connected to the Internet, by using various standardized protocols.

For example, there are video on demand products such as RealVideo (Real Networks Corp.) and QuickTime3 (Apple Computer Inc.) both using HTTP and QuickTime4 (Apple Computer Inc.) using RTSP/RTP (Real Time Streaming Protocol/Real-time Transfer Protocol. Other types of video content transmitting servers have also been realized which can transmit high quality images of MPEG-2 to video content play terminals connected to a broader bandwidth network using ATM (Asynchronous Transfer Mode). For the details of such video content transmitting systems, refer to "Guide to Streaming Multimedia" (published by Wiley Computer Publishing Co.).

In a video content transmitting system having a plurality of video content transmitting servers for transmitting video contents by using various protocols, each video content play terminal receives desired video contents by using its network protocol in the following manner. First, the video content play terminal acquires beforehand information of video content transmitting servers capable of transmitting video contents by the protocol desired by the terminal. Then, the terminal directly accesses the desired server

among those servers identified by the acquired video content transmitting server information. In this manner, the video content transmitting system can transmit the requested video contents to the terminal.

SUMMARY OF THE INVENTION

The video content transmitting system configured in the above manner is associated with the following problems.

In order for each video content play terminal to acquire beforehand information of video content transmitting servers capable of transmitting video contents by using a protocol desired by the terminal, it is essential that the terminal has its own protocol. Prior to receiving video contents, it is necessary to acquire the information of a protocol possessed by each of all independent video content transmitting servers and directly access the video content transmitting server having the protocol same as that possessed by the terminal. If a new video content transmitting server having a new network protocol is added, the protocol information possessed by each terminal is required to be updated.

Another problem is that each video content transmitting server independently manages the network bandwidth to be used, it is not possible to manage the network bandwidth of the whole video content transmitting system.

It is an object of the present invention to solve the above-described problems associated with conventional techniques and provide a video content transmitting system and method capable of determining a video content transmitting server without making each video content play terminal and each video content transmitting server consider a usable network protocol.

It is another object of the present invention to provide a video content transmitting system and method capable of automatically determining a video content transmitting server which can establish a network bandwidth necessary for transmitting video contents, from network resources managed by a video content transmitting system, and transmitting video contents to a target video content play terminal.

In order to solve the above problems, according to an aspect of the invention, there is provided a video content transmitting system for transmitting video contents in response to a request by a video content play terminal connected via a network to a video content transmitting server, the video content transmitting system being provided with a function unit for storing information of a protocol usable by each video content play terminal and each video content transmitting server and/or information of a use state of a bandwidth of a network route to the terminal, and a function unit for determining a server capable of transmitting the requested video contents in

accordance with the information stored by the information storing function units.

According to another aspect of the invention, a function unit is provided for storing a video content destination address to be used for transmitting video contents to the video content play terminal.

The invention provides a video content transmitting system capable of automatically determining a video content transmitting server capable of video content transmission in accordance with information supplied from these function units and transmitting the video contents to the video content play terminal having requested the video content transmission and having a designated address.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a network system constituted of a plurality of video content play terminals and a video content transmitting system having a plurality of video content transmitting servers, according to an embodiment of the invention.

Fig. 2 is a block diagram of a network system constituted of a plurality of video content play terminals and a video content transmitting system having one video content transmitting server, according to a modification of the embodiment.

Fig. 3 is a block diagram showing examples of network routes usable by each video content

transmitting server and each video content play terminal of the video content transmitting system shown in Fig. 1, when video contents are to be transmitted.

Fig. 4 is a table illustratively showing information of network protocols stored at a protocol information manager and being usable by each video content transmitting server and each video content play terminal when video contents are to be transmitted.

Fig. 5 is a table illustratively showing a bandwidth use state, such as a total usable bandwidth and a bandwidth in current use, of each network route between each video content transmitting server and each video content play terminal, the bandwidth use state being stored at a bandwidth information manager.

Fig. 6 is a table illustratively showing destination addresses to be used for transmitting video contents from each video content transmitting server to each video content play terminal, the destination addresses being stored at a destination information manager.

Fig. 7 is a flow chart illustrating an operation to be executed by the video content transmitting system when video contents requested by a video content play terminal are transmitted from the system to the terminal.

Fig. 8 is a flow chart illustrating the details of a process (at Step 702 shown in Fig. 7) to be executed by a transmission processing unit when a

video content transmitting server usable for video contents transmission is determined.

Fig. 9 is a flow chart illustrating the details of a bandwidth check routine (at Step 806 shown in Fig. 8).

Fig. 10 is a flow chart illustrating the operation of notifying a bandwidth information manager of information of bandwidths used by all network routes between the video content play terminal and video content transmitting server and updating the bandwidth in current use after completion of video content transmission.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The details of embodiments of the invention will be given with reference to the accompanying drawings.

Fig. 1 shows in a block diagram a network system having a plurality of video content play terminals and a video content transmitting system having a plurality of video content transmitting servers in accordance with one embodiment of the invention.

Referring to Fig. 1, reference numerals 101 to 103 represent video content play terminals A to C (C'). Reference numeral 104 represents a video content transmitting system of this embodiment. The video content transmitting system 104 illustratively

includes: a system management server 105; a video content transmitting server B 112 connected to a secondary storage unit 113 storing video contents to be transmitted to the video content play terminals A 101 to B 102; and a video content transmitting server C 114 connected to a secondary storage unit 115 storing video contents to be transmitted to the video content play terminal C (C') 103. In response to a request from each of the video content play terminals A 101, B 102, and C (C') 103 connected to networks A and B, each of the video content transmitting servers B 112 and C 114 transmits video contents stored in the secondary storage units 113 and 115.

The system management server 105 has various function units characteristic to the video content transmitting system of this invention. Specifically, the system management server 105 includes: a function unit (hereinafter called a transmission processing unit) 106 for determining a video content transmitting server capable of video content transmission; a function unit (hereinafter called a bandwidth information manager, refer to Fig. 5 for the details) 107 for storing information on a bandwidth use state of each network route between each video content play terminal and each video content server; a function unit (hereinafter called a destination information manager, refer to Fig. 6 for the details) 108 for storing video content destination addresses to be used when video

contents are transmitted from each video content server to each video content play terminal; a function unit (hereinafter called a protocol information manager, refer to Fig. 4 for the details) 109 for storing information of network protocols usable between each video content play terminal and each video content server; a function unit (hereinafter called a video content analysis unit) 110 for calculating a network bandwidth to be used for video content transmission; and a function unit (hereinafter called an address processing unit) 111 for determining a destination address to be used for video content transmission.

The video content play terminal C (C') 103 is connected to the video content transmitting system 104 via two different networks. A video content transmission request is made via the network A, and video content transmission is made via the network B. The video content play terminal C (C') 103 has different addresses, i.e., the video content play terminal C for the network A and the video content play terminal C' for the network B, so that the networks A and B can identify the terminal C (C').

In the configuration shown in Fig. 1, the system management server 105 characteristic to the invention for managing the whole of the video content transmitting servers is used. This system management server may not be used, but a video content transmitting server may have therein the transmission

processing unit 106, bandwidth information manager 107, destination information manager 108, protocol information manager 109, video content analysis unit 110 and address processing unit 111 shown in Fig. 1.

Fig. 2 shows a modification of the embodiment shown in Fig. 1. In this modification, a dedicated server such as the system management server 105 shown in Fig. 1 is not used. Fig. 2 is a block diagram showing the whole configuration of a video content transmitting system having only one video content transmitting server. This network configuration has a parallel configuration similar to Fig. 1, although not shown in Fig. 2. Similar to the case shown in Fig. 1, in response to a video content transmission request from any of three video content play terminals A 201, B 202, and C 203, a video content transmitting system 204 transmits video contents stored in a secondary storage unit 212 to the requested terminal.

The video content transmitting system 204 of this modification includes one video content transmitting server 205. The video content transmitting server 205 has a transmission processing unit 206, a bandwidth information manager 207, a destination information manager 208, a protocol information manager 209, a video content analysis unit 210 and an address processing unit 211 as well as a secondary storage unit 212, respectively having similar functions to those of the transmission processing unit

106, bandwidth information manager 107, destination information manager 108, protocol information manager 109, video content analysis unit 110 and address processing unit 111 possessed by the system management server 105 shown in Fig. 1

Next, with reference to Fig. 3, specific examples of the invention will be detailed with reference to the video content transmission system of this invention shown in Fig. 1.

Fig. 3 is a diagram showing examples of network routes usable when video contents are transmitted between each video content transmitting server and each video content play terminal of the video content transmitting system shown in Fig. 1.

As shown in Fig. 3, the video content play terminals A 301 and B 302 are connected to the video content transmitting server B 304 via paths 306 and 307, a branch 309 and a route 308. The video content play terminal C (C') is connected to the video content transmitting server C 305 via a single route 310.

Fig. 4 is a table illustratively showing information of network protocols stored at the protocol information manager 109 and being usable by each video content transmitting server and each video content play terminal, when video contents are to be transmitted.

In Fig. 4, video content play terminal names are stored in a column 401, video content transmitting server names are stored in a column 402, and network

protocols usable when video contents are transmitted between each video content transmitting server and each video content play terminal, are stored in a column 403.

As shown in Fig. 4, a protocol "UDP/IP" (transmission capacity of 50 k bits/sec for example) can be used for video content transmission between the video content play terminal A 301 and video content transmitting server B 304. A network protocol "HTTP" can be used for video content transmission between the video content play terminal B 302 and video content transmitting server B 304. A protocol "ATM" can be used for video content transmission between the video content play terminal C 303 and video content transmitting server C 305. Other usable protocols include ADSL (asynchronous digital subscriber line), cable TV networks and CS networks. This transmission capacity is 6 M bits/sec for example. As shown in Fig. 3, since there is no network route usable for video content transmission between the video content play terminal A 301 and video content transmitting server C 305, between the video content play terminal B 302 and video content transmitting server C 305, and between the video content play terminal C 303 and video content transmitting server B 304, no protocol (-) is set to the column 403.

Fig. 5 is a table illustratively showing information of a bandwidth use state, such as a total

usable bandwidth and a bandwidth in use, of each network route between each video content transmitting server and each video content play terminal, the bandwidth use state being stored at the bandwidth information manager 105.

In Fig. 5, for each of the network routes 306, 307, 308 and 310 shown in Fig. 3, a network route name is stored in a column 501, a usable total bandwidth is stored in a column 502, and a bandwidth in current use is stored in a column 503.

As illustratively shown in Fig. 5, the network route 306 has a total usable bandwidth of 10 Mbps and a bandwidth in use of 0.5 Mbps. The network route 307 has a total usable bandwidth of 10 Mbps and a bandwidth in use of 1.5 Mbps. The network route 308 has a total usable bandwidth of 100 Mbps and a bandwidth in use of 2.0 Mbps. The network route 310 has a total usable bandwidth of 256 Mbps and a bandwidth in use of 6.0 Mbps.

Fig. 6 is a table illustratively showing information of destination addresses to be used for transmitting video contents from each video content transmitting server to each video content play terminal, the destination addresses being stored at the destination information manager 108.

In Fig. 6, video content play terminal names are stored in a column 601, video content transmitting server names are stored in a column 602, and

corresponding video content destination addresses are stored in a column 603. In this case, the name of each video content play terminal is used as the video content destination address.

As shown in Fig. 6, the video content destination address between the video content play terminal A 301 and video content transmitting server B 304 is a "video content play terminal A", and the video content destination address between the video content play terminal B 302 and video content transmitting server B 304 is a "video content play terminal B".

Since the video content play terminal C 303 is connected to the video content transmitting system via two networks as shown in Fig. 1 and different networks are used for the video content transmission request and video content transmission as described earlier, a "video content play terminal C'" is stored in the column 603 representative of the video content destination address between the video content play terminal C 303 and video content transmitting server C 305.

As shown in Fig. 3, since there is no network route usable for video content transmission between the video content play terminal A 301 and video content transmitting server C 305, between the video content play terminal B 302 and video content transmitting server C 305, and between the video content play terminal C 303 and video content transmitting server B

304, no address (-) is set to the column 603 of the video content destination address.

Fig. 7 is a flow chart illustrating the operation steps to be executed by the video content transmitting system having the structure described with reference to Fig. 1 and Figs. 3 to 6 when video contents requested by a video content play terminal are transmitted from the system to the terminal.

Referring to Fig. 7, upon reception of a video content transmission request from any one of the video content play terminals 101 to 103 (Step 701), the system management server 105 of the video content transmitting system 104 makes the transmission processing unit 106 determine an available video content transmitting server (Step 702, refer to Fig. 8 for the details).

If there is a video content transmitting server capable of video content transmission (YES at Step 703), the address processing unit 111 acquires the video content destination address information shown in Fig. 6 from the destination information manager 108 to thereby determine the video content destination address (Step 705) and transmit the video contents from the determined video content transmitting server toward the video content destination address (Step 706). If there is no video content transmitting server capable of video content transmission (NO at Step 703), the message that the video contents are unable to be

transmitted is returned to the requested video content play terminal (Step 704).

Fig. 8 is a flow chart illustrating the details of the process (at Step 702 shown in Fig. 7) to be executed by the transmission processing unit 106 when a video content transmitting server usable for video contents transmission is determined.

Upon reception of a video content transmitting server determining request at the transmission processing unit 106 (Step 801), the transmission processing unit 106 acquires information of the video content transmitting server capable of transmitting video contents to the video content play terminal which issued a transmission request, from the protocol information manager 109 (refer to Fig. 4) (Step 802).

Next, the transmission processing unit 106 checks whether there is a video content transmitting server whose bandwidth is not yet checked among those video content transmitting servers determined at Step 802 (YES at Step 803), sequentially picks up such a video content transmitting server (Step 805) and checks the bandwidth of the network used by the video content transmitting server for video content transmission (Step 806, refer to Fig. 9 for the details) to judge whether the network bandwidth for video content transmission can be established (Step 807). If there is a video content transmitting server capable of

establishing the network bandwidth (YES at Step 807), it is determined that the video contents can be transmitted from this video content transmitting server to thereafter advance to Step 703 shown in Fig. 7 (Step 808).

If there is no video content transmitting server capable of establishing the network bandwidth for video content transmission (NO at Step 803), it is judged that the video contents cannot be transmitted, to thereafter advance to Step 704 shown in Fig. 7 (Step 804).

Fig. 9 is a flow chart illustrating the details of the bandwidth check routine (at Step 806 shown in Fig. 8).

First, a bandwidth necessary for transmitting requested video contents is acquired from the video content analysis unit 110 (Step 902). Next, the bandwidth information manager 107 (refer to Fig. 5) is checked, and if the bandwidth cannot be established at all routes to be used for transmitting the video contents from the video content transmitting server to the video content play terminal (NO at Step 903), one unchecked route whose bandwidth is not established is acquired from the bandwidth information manager 107 (Step 904) to acquire the current bandwidth use state of the route (Step 905).

If the value of the bandwidth necessary for video content transmission added with the bandwidth in

current use (column 503) dose not exceed the total usable bandwidth (column 502) (YES at Step 906), the bandwidth in current use (column 503) is updated (Step 907) to thereafter return to Step 903 whereat it is checked whether the bandwidth can be established at the next route.

This process is performed for all network routes to be used for video content transmission. For example, if video contents are transmitted from the server 304 to terminal 301 shown in Fig. 3, this process is performed for the routes 306 and 308. If the bandwidth can be established for all necessary network routes (YES at Step 903), it is judged that the bandwidths of all network routes necessary for the video content transmitting server are established (Step 908), to thereafter execute Step 807 and following Steps shown in Fig. 8.

If there is even one route unable to establish the bandwidth (NO at Step 906), the bandwidth in current use (column 503) updated until then is changed to the bandwidth before updated (Step 909). It is judged that the bandwidth cannot be established for the video content transmitting server, and the process returns to Step 807 shown in Fig. 8 (Step 910) whereat Step 803 and following steps are again executed for the next video content transmitting server.

Fig. 10 is a flow chart illustrating the operation of notifying the bandwidth information

manager 107 of information of bandwidths used by all network routes between the video content play terminal and video content transmitting server and updating the bandwidth in current use (column 503 in Fig. 5) after completion of video content transmission.

First, information of the bandwidth of the network used for video content transmission is acquired from the video content analysis unit 110 (Step 1002). Next, the bandwidth information manager 107 (refer to Fig. 5) is checked and if the bandwidths of all network routes used between the video content transmitting server having performed the video content transmission and the video content play terminal having performed the video content reception are not yet released (NO at Step 1003), information of one route still not checked among those network routes between the video content transmitting server having performed the video content transmission and the video content play terminal having performed the video content is acquired from the bandwidth information manager 107 (Step 1004) to acquire the use state of the route (Step 1005).

Next, the bandwidth not in current use after the video content transmission completion is subtracted from the bandwidth in current use (collum 503) (Step 1006) to release the bandwidth to thereafter return to Step 1003 whereat a similar process is repeated for the unchecked route. This process is repeated for all network routes (NO at Step 1003) to thereafter

terminate the release process (Step 1007).

The description has been given above by taking as an example the system configuration of the embodiment shown in Fig. 1. The system configuration of the modification shown in Fig. 2 can be used in a similar manner. It is therefore possible to manage network resources of the video content transmitting system, to automatically determine a video content transmitting server capable of establishing a network bandwidth necessary for video content transmission, and to automatically transmit the video contents of the video content transmitting server to the video content play terminal requested the video content transmission. It should be understood from the above description of the embodiment that each function unit of the system management server can be realized by software (programs) including tables.

As described so far, by adopting the configuration of the embodiment or its modification of this invention, it is possible to automatically determine a video content transmitting server capable of establishing a network bandwidth necessary for all network routes to be used for video content transmission, and to automatically transmit the video contents to the video content play terminal at a predetermined address, in response to a video content transmission request from any one of a plurality of video content player terminals using various network

protocols, while the video content play terminal is not required to be conscious of which video content transmitting server can transmit the video contents by using the network protocol the terminal side uses.